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THE ROLE OF COLLABORATION NETWORKS FOR INNOVATION IN IMMIGRANT-OWNED NEW TECHNOLOGY-BASED FIRMS

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Abstract
This paper investigates the importance of the network of collaborations with other firms, research institutions, and business associations as key drivers of innovation, providing a comparison between immigrant-owned firms and non-immigrant-owned firms. We hypothesise that the network of collaboration is more important for innovative activities of immigrant entrepreneurs than for natives, due to their migrant condition, and that immigrant entrepreneurs' acculturation to the host country culture moderates the influence of such network. We test our hypotheses on a unique matched-pair sample of immigrant and native domestic entrepreneurs active in high-tech mainstream (non-ethnic) markets. Our results show that universities and research institutions along with business associations are more important for immigrant-owned companies; we further show that immigrant entrepreneurs' acculturation to the host country culture acts as a substitute for interactions with business associations. These findings are highly relevant for the academic and policy discourses on the link between immigrant entrepreneurship and innovation in developed countries.

Key words: immigrant entrepreneurs; new technology-based firms; innovation; collaboration networks; acculturation

Jel codes: O31 (Innovation and Invention: Processes and Incentives), J61 (Immigrant workers), L26 (entrepreneurship)

1. Introduction

The economic and social contribution of immigrant entrepreneurs in developed economies is undoubtedly significant (Economist, 2008; Baycan-Levent and Nijkamp, 2009; Arslan, 2014). In contrast to the common misbelief that depicts immigrants as almost entirely concentrated in ethnic markets (e.g., Zhou, 2004; Ndofor and Priem, 2011; Arrighetti et al., 2014), immigrant-owned enterprises operate in a wide variety of markets and sectors, such as in technology, business services, finance, and creative or cultural industries (e.g., Smallbone et al., 2005; Cucculelli and Morettini, 2012). We argue that for these firms, notably those in high-tech sectors, innovation is a key factor in creating and sustaining competitive advantage, similar to other small and medium-sized enterprises (SMEs) (e.g., Hult et al., 2004).

The literature on technological change and innovation has unequivocally established that firms' external networks allow the acquisition of knowledge from a wide set of organizations, which is necessary for the innovation activities of firms (e.g., Arora and Gambardella, 1990; Cassiman and Veugelers, 2006; Frenz and Ietto-Gillies, 2009), including SMEs (see e.g., Brunswicker and Vanhaverbeke, 2015). Similarly, the social embeddedness of immigrant entrepreneurs interacting with the local opportunity structure has been highlighted as a key determinant of immigrants' entrepreneurial strategies and performances (Kloosterman, 2010). For instance, whereas immigrant entrepreneurs can exploit their international networks to resort to export opportunities (e.g., Neville et al., 2014; Wang and Liu, 2015; Morgan et al., 2018), evidence suggests that the majority of them do not internationalize (e.g., Neville et al., 2014; Portes et al., 2002; Rusinovic, 2008). In this respect, many studies have provided evidence on the robust and ramified system of family and co-ethnic social networks in the host country, which provides access to information, financial resources, a flexible labour force, supplies, and demand (e.g., Chaganti and Greene, 2002; Nee and Sanders, 2001; Portes and Sensenbrenner, 1993). The literature thus suggests that immigrant entrepreneurs are embedded in different networks with respect to native entrepreneurs, partly due to the homophilous nature of the network ties established in the host country (Kerr and Kerr, 2019). For this reason, exploring the

networking behaviour of immigrant entrepreneurs and comparing it to that of their native counterparts may shed new light on the role of networking for firms' performances (Neville et al., 2014; Kerr and Kerr, 2019), particularly for innovative businesses.

This paper aims to explore this issue, thus seeking to understand the importance of networking for the innovative activities of immigrant-owned firms that operate solely in the domestic market and to compare them with native entrepreneurs. Drawing on the literature on the role of networks of collaboration for innovation and on immigrant entrepreneurship, we specifically develop arguments on the effect of an entrepreneur's immigrant status on the relationship between interactions with other actors such as firms, academic and research institutions, and business associations and the innovative activity of firms. In addition, acknowledging that immigrant entrepreneurs are heterogeneous in terms of their level of acculturation to their home and host cultures (Berry, 1997), we explore how acculturation to the host culture moderates the effect of external collaborative networks and innovation activities in immigrant-owned firms.

We test our hypotheses via a regression analysis on a unique matched-pair sample of 71 immigrant entrepreneurs and 69 native entrepreneurs active in domestic new technology-based firms in the Emilia-Romagna region of Italy and catering to mainstream (i.e., non-ethnic) markets. The data were collected by means of a rich survey providing detailed information about owner-managers and their businesses. Our findings show that interactions with academic and research institutions and with business associations are more important for firms owned by immigrant entrepreneurs than for firms owned by native entrepreneurs, while interactions with other firms are more relevant for native entrepreneurs. Additionally, when exploring the moderation effect of the immigrants' acculturation to the host culture, we find that interactions with business associations are less relevant for immigrant entrepreneurs highly assimilated to the host country culture.

The contribution of this work is threefold. First, it contributes to the academic literature on firm-level innovation by showing whether external drivers of innovative activity, such as networks, matter to a different extent for immigrant and native entrepreneurs. Second, it adds to the literature

on immigrant entrepreneurship by shedding light on the factors that nurture innovation performance, and therefore the potential competitive advantage, of immigrant-owned companies active in high-tech sectors. Third, it provides a general contribution to the entrepreneurship literature by studying immigrant status as a characteristic that makes entrepreneurs heterogeneous in their networking behaviour. The findings of this work yield important implications for policies aimed at fostering the performance of immigrant businesses.

The rest of the paper is organized as follows. In section 2, we discuss the literature concerned with innovation activities and immigrant entrepreneurship and develop our hypotheses. In section 3, we present the data, the variables and the methodology employed in the empirical analysis. Section 4 shows the results, including robustness checks. In section 5, we conclude and provide the theoretical, managerial and policy implications of our work.

2. Theoretical background

2.1 The role of networks of collaboration for innovation

The systems of innovation, evolutionary economics and open innovation approaches stress the importance of interactions between internal and external factors in firms' innovation processes (see, e.g., Freeman, 1987; Lundvall, 1988, 1992; Edquist 1997, 2010; Chesbrough, 2006).[1] These theoretical perspectives suggest that all firms' decision to innovate and, ultimately, their innovation performance are influenced by the collaboration networks developed by entrepreneurs for their companies. The interactions that firms establish and maintain within their environment represent a way of accessing external knowledge sources but also a source of selective pressure that is fundamental to innovative activities (Del Rio, 2015; Scandura, 2017). These arguments particularly

[1] In the systems of innovation approach, innovations are not developed and implemented in isolation, but within a technological, socio-cultural and an institutional context. For an innovation system to successfully develop and exploit technologies, its three coevolving building blocks—technology, knowledge and skills, and networks of actors and institutions—need to be aligned (Malerba, 2004; Woolthuis et al., 2005). According to evolutionary economics, differences in firms' performance mainly rest on idiosyncratic features that are essentially related to the creation and accumulation of knowledge, which is partly tacit and firm specific (Nelson, 1991; Hodgson, 1998). The open innovation paradigm assumes that companies can and should exploit both internal ideas and paths to markets as well as external ones to advance their technology and to stay competitive on the market (Chesbrough, 2006).

apply to SMEs, which command fewer financial and human resources, count on less internal R&D, and generally face more uncertainties and barriers to innovation as compared with large companies, thus resorting to networks with diverse external actors to support their innovation efforts (e.g., Zeng et al., 2010).

Previous studies have investigated the impact of collaborating with different external partners on SMEs' innovation performance (see e.g., Belderbos et al., 2004; Faems et al., 2005; Nieto and Santamarìa, 2007), suggesting some stylized facts. For instance, research suggests that collaboration with other firms, such as clients and suppliers, is useful to accrue information about technologies, users' needs and markets (Miotti and Sachwald, 2003; Faems et al., 2005). Firms conducting R&D collaboration with universities and research institutions are more likely to appropriate the output of their research activities through patenting and, specifically, through the co-ownership of patents (Belderbos et al., 2004; Huang and Cheng, 2015). Finally, cooperative networks established with intermediary institutions lead to better innovative performance, thanks to the provision of technology information (Zeng et al., 2010) or direct and indirect support for the development of networks and collaboration for innovation (Lee et al., 2010).

Cumulated evidence therefore suggests that establishing and maintaining network relationships with other companies, universities and research institutions, and intermediary institutions has a positive influence on SMEs' innovation performances. In this work, we qualify these empirical findings to hypothesise that the relationships with those actors are more important for the innovative activities of immigrant-owned companies than for their native counterparts, as we argument in the following sections.

2.2 Networks of collaboration and innovation in immigrant-owned firms

The literature about immigrant entrepreneurship has shown a substantial diversity in the antecedents and outcomes of entrepreneurship both within immigrant entrepreneurs (e.g., Ram et al., 2013), and between immigrant and native entrepreneurs (e.g., Arrighetti et al., 2014). Many immigrant-owned

firms are active in expanding or abandoned market niches, or established to meet the needs of a specific ethnic community (supplying the so-called “ethnic” products or services), often exploiting opportunities offered by the “enclave economy” (for a review, Zhou, 2004). These firms draw on trusted network relationships established by the entrepreneurs within the ethnic community (e.g., Chaganti & Greene, 2002) to access information, markets, and resources in a flexible and informal way (e.g., Kloosterman and Rath, 2010; Portes and Sensenbrenner, 1993; Masurel et al., 2002). In this paper, we are rather interested in the increasing number of immigrant-owned firms that operate into mainstream markets (Ram and Hillin, 1994; Engelen, 2001; Barrett et al., 2002), such as “post-industrial/high-skilled” sectors related to technical, financial, legal and administrative advisory services (Kloosterman, 2010).

By entering mainstream markets, immigrant entrepreneurs compete with native business owners and rely less on access to information, resources and level of demand for products or services from the family and co-ethnic community to sustain their competitive advantage (Arrighetti et al., 2014; Barrett et al., 2002). We expect that immigrant entrepreneurs in these markets invest more heavily into building relationships with other non-co-ethnic or native business owners, formal institutions representing economic interests, or professional counsellors (Amin, 1995; Engelen, 2002), thus emphasizing the bridging of social capital with indigenous actors rather than the bonding of social capital within the co-ethnic community (e.g., Canello, 2016; Light and Dana, 2013).

As noted in previous studies, immigrant entrepreneurs have diverse backgrounds that endow them with different network connections in the host country compared to a typical native entrepreneur in the same location (Kerr and Kerr, 2019). For instance, immigrant-owned firms tend to rely on a smaller network of local advisors, mentors, and partners (Raijman and Tienda, 2000) and have limited participation in formal consultancy networks (e.g., retail groups or trade associations) in comparison with native-owned businesses (Kloosterman, 2000; Sahin et al., 2011). Other studies have shed light on the risks faced by immigrant entrepreneurs of being marginalized and exposed to power imbalances along the supply chain (e.g., Canello, 2016; Ram et al., 2011). We reason that this can be

explained by the phenomenon of homophily (i.e., the propensity of individuals to associate with similar others) (McPherson et al., 2001). Indeed, specific language issues or cultural differences are often reported by immigrant entrepreneurs (Heilbrunn and Kushnirovich, 2007), who might thus find it easier to establish external collaboration networks with other actors perceived as similar in these terms, while finding it harder to collaborate with indigenous firms and institutions. However, we know that homogeneous, bonding networks can potentially limit the amount of knowledge and novel information that are needed in innovation processes, whereas diverse, bridging networks with other actors might result in complementary or new information and practices that are beneficial to firm innovation (e.g., Luo and Deng, 2009). Due to their "ethnic liability" (Jiang et al., 2016) and different backgrounds, labelled by some authors as "migrant condition" (Hormiga and Bolívar-Cruz 2015), we maintain that immigrant entrepreneurs will attribute significantly more importance to the establishment of networks of collaboration with host country actors to support an innovation strategy that allows them to be competitive in mainstream markets. Building on the insights offered by the literature on collaboration networks for innovation, we investigate the different role played by networks with other firms, universities and research centres, and business associations for innovation activities in immigrant- and native-owned firms.

2.3 Hypotheses development

A large body of empirical contributions show that innovation performance at the firm level is positively and substantially influenced by establishing linkages with other companies, such as clients, suppliers and competitors (see, e.g., Arora and Gambardella, 1990; Cassiman and Veugelers, 2006; Zeng et al., 2010). Inter-firm linkages are useful for tapping into external knowledge, gaining fast access to technologies or markets, reducing costs, benefitting from economies of scale in joint R&D and/or production, and sharing risks and reducing the uncertainties associated with R&D and innovation processes (Fischer and Varga, 2002), especially within industries characterized by complex and inter-sectoral processes of new technology development (Hagedoorn, 1993).

Interactions with other firms are largely based on trust, which can be granted by perceived similarity with partners (e.g., in terms of culture, language, business vision), by shared experience or activities, or by sanctioning systems within the network (e.g., Blomqvist et al., 2005; Canello, 2016; Sahin et al., 2011). In light of our previous discussion on the heterogeneity of the backgrounds of immigrant and native entrepreneurs, we posit that immigrant-owned firms will likely benefit more from interactions with other firms in developing innovative activities. Specifically, we expect such bridging networks to bring two positive contributions to innovation in immigrant-owned firms. First, they bring cognitive diversity and complementary knowledge and practices (e.g., Luo and Deng, 2009). Second, collaborations with firms, especially with those located downstream and upstream in the value chain, reduce marginalization and exploitation risks for immigrant-owned firms (cf. Canello, 2016; Ram et al., 2011).

Similarly, we argue that interactions with universities and research institutions are likely to positively relate to the probability of innovating more for immigrant entrepreneurs than for native entrepreneurs. Companies often turn to academic and research institutions to support their innovative activities. The positive effect of interactions with academia and research institutions on firms' innovative activities has been established for several reasons. Firstly, such interactions contribute to reducing R&D market failures and realizing the full social benefits of R&D investments (Martin and Scott, 2000; Poyago-Theotoky et al., 2002). Secondly, firms seek to access university research infrastructures and expertise to gain opportunities to recruit high-skilled personnel and keep abreast of cutting-edge academic research (OECD, 1998; Scandura, 2016). Immigrant-owned companies operating in non-ethnic markets, notably in high-tech sectors, are often endowed with personnel having high levels of skills and qualification (Kloosterman, 2010). However, these businesses face legal and bureaucratic regulation obstacles, as well as strict labour market regulations, associated with the entry into and residence in the host country (Cerdin et al. 2014; Portes and Rembaut 2006). Arguably, immigrant entrepreneurs will attribute high importance to the establishment of relationships with academic and research institutions, which could provide a more supportive

environment for innovation by recognizing their education and technical expertise. We argue that collaborations with academic and research institutions might be facilitated by the possession of a common technical/technological background, which can help overcome the barriers arising from the different cultural and institutional norms governing the research system and the business world (Dasgupta and David, 1994; Mora Valentin, 2000).

Finally, the academic literature shows that intermediary organizations, such as business associations, bring benefits to firms' innovation activities (Lee et al., 2010; Zeng et al., 2010). Business associations are non-profit organizations often created by entrepreneurs who see a need for engaging with peers to improve their conditions (Aldrich et al., 1998). They typically perform innovation-enabling roles in the territory where they are located, through their specialized competences and knowledge (Dalziel, 2006). Firms resort to business associations to sustain their innovation activities, by accessing specialized information (e.g., laws and regulations on intellectual property rights, funding and programmes to sustain technological development), consulting services to strengthen and protect property rights, and activities supporting the facilitation of vertical and horizontal coordination, and by upgrading worker training (Doner and Schneider, 2000). Business associations enable innovation activities by shaping the networks and markets in which firms operate in various ways. According to Dalziel (2006), these include the identification of agents, support for creating ties between agents, increased provision of access to resources through network brokerage, and facilitation of joint action through network closure.[2] The support of business associations and other intermediaries may prove to be particularly useful for SMEs, who often lack the required network-related expertise and skills to develop a fruitful network of collaboration (Zeng et al., 2010). As far as immigrant-founded businesses are concerned, extant research shows that the provision of policy support measures to these firms is problematic for various reasons, including policy-makers' inability to meet the needs of immigrant businesses and the lack of coordination between the support

[2] Empirical evidence on successful biotechnology clusters (Cambridge, US and Cambridge, UK) show that they have exceptionally well-developed associations that manage collective affairs, lobby to the government, organise common purchasing and other services such as promotion, educational placement and careers development for its member firms (Cooke, 2002).

for immigrant-owned firms and mainstream business support networks and initiatives (e.g., Crick et al., 2001; Ram et al., 2017). Business associations may act as intermediary bodies for immigrant entrepreneurs with regard to several dimensions of business activities (e.g., consultancy on fiscal and regulatory aspects, human resource management, commercial development), including those that relate to innovation (e.g., new product development, intellectual property rights management, connection to innovation networks) (OECD, 2011).

In line with these arguments, we formulate our hypotheses as follows:

Hp 1: Interactions with other firms increase the probability of innovating more for immigrant owned firms than for comparable native-owned domestic firms.

Hp 2: Interactions with academic and research institutions increase the probability of innovating more for migrant-owned firms than for comparable native-owned domestic firms.

Hp 3: Interactions with business associations increase the probability of innovating more for migrant-owned firms than for comparable native-owned domestic firms.

In addition to comparing the role of external networks for innovation in immigrant and native entrepreneurship, we acknowledge that immigrant entrepreneurs operating in post-industrial/high-skill markets might not be a homogeneous group. As some scholars have suggested, in the last decade, immigrants have increasingly become "super-diverse" in terms of ethnicity, immigration status, labour market experiences, gender and age profiles, or spatial distribution (Vertovec, 2007). In this paper, we take into account immigrant entrepreneurs' heterogeneity in their level of acculturation to their host country cultures (Berry, 1997).

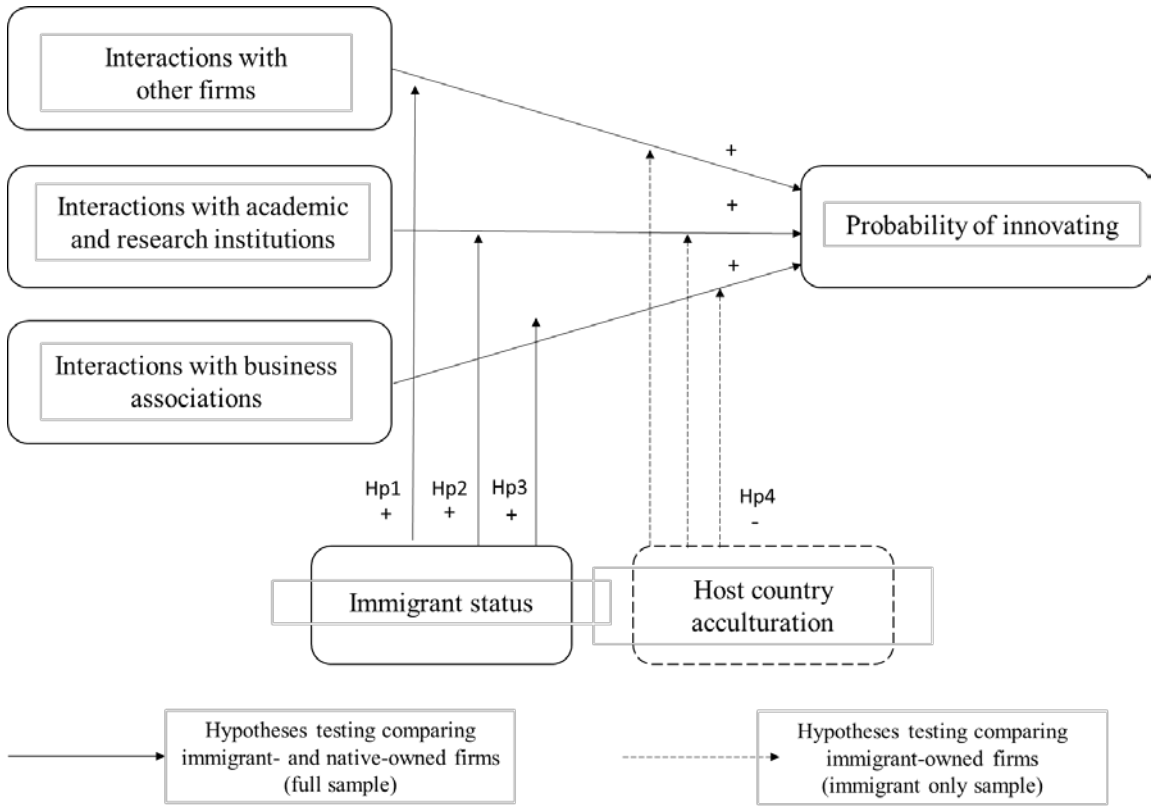
Acculturation has been defined as "those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact with subsequent changes in the original culture patterns of either or both groups" (Redfield et al., 1936, p. 149). While the term acculturation can be used as a neutral one to account for changes taking place in one or both groups, in practice, it often refers to changes in one of the groups—i.e., the acculturating group (Berry, 1990).

In this study, we adopt this view and refer to an individual-level concept of acculturation, i.e., psychological acculturation, which has been shown to be a key driver of individual behaviours (Berry, 1997). Acculturation can impact immigrant entrepreneurs' preference for maintaining ethnic bonding networks vs. non-ethnic bridging networks and thus entrepreneurial decision making and innovation activities (Dheer and Lenartowicz, 2018). Specifically, we argue that immigrant entrepreneurs' interest in adopting the mainstream culture of the receiving country, and hence their level of acculturation to the host culture, acts as a substitute with respect to networks with external local actors such as other firms, research and university institutions, and business associations. We therefore posit that acculturation to the host country culture has a negative moderating effect on the impact of external networks on firm innovation. We postulate the following hypothesis:

Hypothesis 4: The higher is the acculturation of migrant entrepreneurs to the host country culture, the lower is the impact of interactions with external actors (e.g., other firms, academic and research institutions, business associations) on the probability of innovating.

We summarize the hypothesized relationships of our work in Figure 1.

Figure 1 – The research model



3. Data, variables and methods

3.1 Sample

This study is based on primary data collected from entrepreneurs in new technology-based firms (NTBFs) (Colombo et al., 2004) located in the Emilia-Romagna region (Northern Italy).[3] Immigrant entrepreneurs in Western countries are increasingly establishing activities in high-tech domains (e.g., Hart and Acs, 2011; De Lange, 2018). These companies represent a particularly suitable context for studying the role of networks of collaboration for innovation because they compete to gain market shares in mainstream, high-growth markets. The Italian context is interesting in this regard because Italy has a quite large share of self-employed immigrants—14.3% in 2016 (OECD/EU, 2018), of which a relevant share is found in the selected region (Regione Emilia-Romagna, 2013). While most

[3] NTBFs are defined with reference to the OECD definition of 'technology intensive' industries according to their average R&D intensity. NTBFs can belong to 'High-Tech' (R&D intensity above 8.5%) or 'Medium-Tech' (R&D intensity between 3.5% and 8.5%) industries (Almus & Nerlinger, 1999).

of their activities are concentrated in services, notably trade, as well as in construction, they also operate in high-tech sectors such as ICT (OECD, 2014).

Similar to other studies comparing immigrant and non-immigrant entrepreneurs (e.g., Chaganti et al., 2008), we employed a matched-pair design to build our sample. The sampling and data collection were carried out in two steps. The first step consisted of the selection of NTBFs owned and managed by foreign-born entrepreneurs from official business register of the Italian Chamber of Commerce (Unioncamere) (summary in Appendix, Table A1). The sample included independent, active, contactable firms, operating in the domestic market, owned and actively managed by at least one foreign-born entrepreneur (n=71; response rate=50.7%).

In the second step of the data collection, we matched the previously identified and interviewed 71 firms with firms owned and managed by Italian entrepreneurs. The methodological literature recommends that matched-pair samples be selected to allow firm comparability on a range of firm characteristics (Kerlinger and Lee, 2000). Accordingly, we matched on the product/service produced, firms' industry, and the age of the firm and the entrepreneur (e.g., Chaganti et al., 2008) by drawing from the business registers held by the Unioncamere. Two immigrant-owned companies carried out very specific types of business, so that we could not match them with any Italian-owned company. We interviewed 69 Italian owner-managers in 69 firms.

The full sample includes 140 entrepreneurs and firms. The data were collected through face-to-face interviews conducted with entrepreneurs on their company's premises. Questions were based on an Italian-language, structured questionnaire aimed at collecting a wide range of information about the entrepreneurs and their firms. Given that the questionnaire deals with self-reported measures, we designed it with care to reduce potential sources of common method bias (e.g., obtaining measures from different sources; separating the measurement of prediction and criterion variables; using reverse-coded and negatively worded items) (Podsakoff et al., 2003). The questionnaire was pre-tested on a panel of ten academics and entrepreneurs who were not involved in the study, from whom

we obtained feedback on completeness, clarity, and wording. When available, we complemented interview data with secondary data (e.g., companies' websites and companies' financial statements).

To test for non-response bias, we compared respondents with non-respondents by running t-tests and anova analyses. We found no significant differences with regard to the industry, location, legal form of the company, and age of entrepreneurs. We found that respondent firms were slightly younger than non-respondents (mean difference=1 year; $p<.01$) but considered this to be a negligible difference. We conclude that non-response bias is not an issue in our study.

3.2 Variables

3.2.1 Dependent variable

The dependent variable in our analysis was worked out from a survey question that mimics questions from various innovation surveys (e.g., the European Union Community Innovation Survey) aimed at collecting insights into innovation activities by focusing on tangible innovation outputs, such as product and process innovation, and IPR activities. In particular, the question in our survey asks the following: "Has your company carried out any innovative activity in the past 3 years, such as (1) new products/services introduced to the markets before other competitors; (2) new products/services for the firm; (3) new production processes; (4) new supply chain methods; (5) new support activities; (6) registered patents; (7) filed patent applications; (8) registered trademarks; (9) registered copyrights; (10) no innovation". Innovative activity hence refers to both incremental and radical innovation outputs, excluding inputs such as R&D expenditure and/or R&D workforce. We identify our dependent variable (*innov*) as a binary indicator taking the value of 1 if companies carried out any of the innovative activities described in items (1) to (9), and 0 otherwise. The share of firms declaring any innovation activity is 55% (77 firms), the vast majority of which declared having introduced new products/services new to the market (52 firms, corresponding to 37% of all firms and 67.5% of innovative firms) or new to the firm (20 firms, corresponding to 14% of all firms and 26% of innovative firms). The share of native entrepreneurs who carried out innovation activities is 58%,

while it is 52% among immigrant entrepreneurs. The difference between the two groups of entrepreneurs is not statistically significant (see Table 1 for further information).

3.2.2 Independent variables

To test hypotheses 1 to 3 we employ three non-exclusive dummy variables indicating whether respondents interacted with firms (*firms*), universities and research institutions (*univ*), and business associations (*busass*). The variables were identified from three questions about interactions with each of these actors: "How much did your company interact with firms/universities (or research centres)/business associations during the last year?", measured on a 1-7 scale, where 1=very little and 7=very much. The three binary variables *firms*, *univ*, *busass* equal 1 when the response of a given respondent is higher than the median value of the response in the full sample.[4] These variables therefore take into account the relative importance (relative to the sample under investigation) of interactions with external-to-the-firm organizations. Table 1 shows the distribution of the binary variables. Interactions with firms and business associations are quite widespread for companies in our sample (mean of *firms*=0.45, mean of *busass*=0.38), while interactions with universities and research institutions are less common (mean of *univ*=0.19). These variables have a similar distribution in the sub-samples of immigrant and non-immigrant owned businesses. However, the data show that immigrant-owned firms interact more with academic and research institutions compared to native-owned firms, while the opposite holds for interactions with business associations.

3.2.3. Moderation variables

First, the moderating factor used to test hypotheses 1-3 is the key variable identifying immigrant-owned companies: this is a dichotomous indicator (*immigr*) that is equal to 1 for companies established in Italy by immigrant (i.e., foreign-born) entrepreneurs.

[4] Given that the mean and standard deviation are invalid parameters when the data are on an ordinal scale (Allen and Seaman, 2007), we opted to use the median to identify our dichotomous indicators.

Second, to test hypothesis 2, we exploit a variable measuring orientation to the host culture (*acculturation*). Several measures of acculturation exist, relying either on demographic variables as proxies of acculturation (e.g., generational status, age at immigration, years lived in the new country) or on psychometric scales (Ryder et al., 2000). Because demographic indicators are quite rudimentary in accounting for individual differences (Ryder et al., 2000), we prefer to use a validated psychometric scale. Following Arends-Tóth and Van de Vijver (2006), we choose a scale having the desirable characteristic of adopting a bicultural perspective on the measurement of acculturation, and therefore presenting cultural maintenance (heritage acculturation orientation) and adoption of the mainstream culture (host culture acculturation orientation) as two independent constructs. We employed the scale created by Sánchez and Fernández (1993), which measures immigrants' acculturation to the host country culture. through the following three 5-point Likert scale items: "I have difficulties identifying with *host country nationality* people"; "I think of myself as being *host country nationality*", and "If someone insults *host country*, I get angry", where we replaced *host country/host country nationality* with Italy/Italian. Since this scale measures the degree of immigrants' acculturation to the host country, it was not used for Italian entrepreneurs. In fact, we are interested in the moderation effect of acculturation to the host culture in the sub-sample of immigrant entrepreneurs only. The variable *acculturation* is a factor score created by averaging raw scores of the three items ($\alpha = 0.69$; min=1, max=5, mean=4.09), whose factor loadings ranged between 0.68 and 0.84.

3.2.3 Control variables

Building on the vast literature studying the link between innovation and firms' characteristics, we selected a vector of firm-level variables that are likely to influence the probability of pursuing innovative activities. In particular, we focus on firm age, size, R&D effort and industry as the most important determinants of innovation. Age may have two opposite effects on innovation: on the one hand, firms' experience in the markets increases their absorptive capacity through learning processes (Cohen and Levinthal, 1989), hence increasing their ability to innovate; on the other hand, older firms

may face “organization inertia” due to hardly changeable routines (Nelson and Winter, 1982), hence limiting their ability to face the innovation challenge (Hannan and Freeman, 1984). To control for the age effect, we use a count variable indicating the years since foundation (at the time of the survey) as indicated by respondents (*agefirm*). Firm size is perhaps one of the most historically debated determinants of innovation, either supporting the view that small entrepreneurial firms are more likely to innovate or that large companies who hold some degree of monopoly power are the most likely to innovate (Schumpeter, 1950; Nelson and Winter, 1982b). To control for firm size, we add the 3-year lagged company turnover (*turnover_t-3*, in log) collected from AIDA-Bureau Van Dijk, in the case of limited liability companies, or self-reported by the entrepreneur, in the case of unlimited liability companies. In addition to accounting for size effects, this variable also allows us to take into account firms’ growth trends. To control for direct determinants of innovative activities, such as R&D expenditure, we include the 3-year lagged value of the intangible fixed assets (*intang_t-3*, in log), collected from AIDA-Bureau Van Dijk, in the case of limited liability companies, or self-reported by the entrepreneur, in the case of unlimited liability companies[5] Intangible fixed assets provide a reliable measure of firms’ effort in R&D because R&D-related costs fall into the category of internally generated intangible assets. Importantly, R&D effort directly influences the propensity to innovate as well as the extent of firms’ reliance on external sources of knowledge (Cassiman and Veugelers, 2006). Economies of scale and scope, along with entry barriers, also influence companies’ innovation propensity (Acs and Audretsch, 1987). For this reason, we control for industry determinants via three dummy variables, equalling 1 if companies belong to ICT, manufacturing and other sectors respectively (*ict, manuf, others*), based on the NACE-rev2 industry sector. Table 1 presents the list of variables along with their description and main statistics.

[5] For companies established at time t-3, t-2 and t-1, we use the first available data on turnover and intangible fixed assets.

Table 1 - Variable list, description and descriptive statistics.

Variable	Description	Mean	SD	Min	Max	Mean immigr	Mean non-immigr	Difference p-vlaue
Innov	Dummy 0/1 for innovation activity (last three years)	0.55	0.50	0	1	0.52	0.58	0.755
Firms	Dummy 0/1 for interaction w. firms; 1 if >median(firms_value) (t-1)	0.45	0.50	0	1	0.48	0.42	0.244
Univ	Dummy 0/1 for interaction w. univ.; 1 if >median(univ_value) (t-1)	0.19	0.39	0	1	0.24	0.13	0.049
Busass	Dummy 0/1 for interaction w. assoc; 1 if >median(busass_value) (t-1)	0.38	0.48	0	1	0.34	0.42	0.840
Accult	Factor score based on 3-items, 5-point Likert scale of immigrants' orientation toward the host country (Sánchez and Fernández, 1993)	4.09	0.89	1	5	-	-	-
Immigr	Dummy 0/1 for immigrant-owned firms	0.51	0.50	0	1	1	0	-
Agefirm	Age of firms at time of survey	5.86	3.70	1	12	5.7	6	0.713
Turnover(t-3)	Turnover in t-3	340113.6	947517.6	0	7656734	216635	467171	0.059
Intang(t-3)	Net intangible fixed assets in t-3	51235.8	388570	0	4495334	23340.5	79939	0.804
Manuf	Dummy 0/1 for manufacturing firms	0.53	0.50	0	1	0.57	0.47	0.121
ICT	Dummy 0/1 for ICT firms	0.41	0.50	0	1	0.41	0.40	0.487
Others	Dummy 0/1 for firms in other sectors	0.06	0.24	0	1	0.01	0.11	0.006

N = 140 except for *accult* (N=71); *** p<0.01, * p<0.1, - t-test not performed

The 140 firms were active in manufacturing sectors (53%), including the production of computers, electronics and optical products, the production of electrical and non-electrical equipment, and the production of machinery; in ICT sectors (41%), including the production of software and the supply of ICT services; and in other sectors (6%), such as specialized construction works and research and development. The localization of companies is representative of the distribution of industrial activities in the region (Appendix, Table A2). On average, these firms were established by two partners in 2006 and employed approximately 4 employees at the time of the interviews. We found no significant differences between immigrant and native-owned firms with respect to several firm-level characteristics, such as size, age, equity capital at foundation, and targeted client and market location (Appendix, Table A3).

Approximately 76% of entrepreneurs were male. On average, respondents were 41 years old (*SD*=8.21). They completed 15 years of education (*SD*=3.23) and had previous professional experience (13 years on average) before starting their own business (*SD*=8.24). Immigrant

entrepreneurs migrated to Italy at 15 years old on average (*SD*=11); 35% of them had previously worked in their country of origin for 2 years, on average. Comparing immigrant and native entrepreneurs on a set of key characteristics, including age, gender, human capital, entrepreneurial experience and entrepreneurial motivation, reveals no significant differences, with the exception of the length of working experience in Italy (i.e., immigrants have spent less working time in Italy; $p<0.10$) (Appendix, Table A4). This confirms that our matched-pair strategy was highly effective in identifying very similar pairs of companies.

3.4 Methodology

To test hypotheses 1 to 3 econometrically, we estimate an equation where the probability of innovating depends upon collaboration with firms, universities, and business associations, along with their interaction with the dummy *immigr* and the vector of control variables. Our empirical estimations rely on probit regressions with robust standard errors. We also estimate the marginal effects of the coefficients and plot the interaction effects to allow the interpretation of results as exact probabilities. To test hypothesis 4, we run a probit model on the sub-sample of immigrant firms, where the variables indicating collaborations with firms, universities and business associations are interacted with *accult*, which indicates the extent of immigrants' acculturation to the host culture.

4. Results

4.1 Main results

Pairwise correlations among our set of dependent, independent and control variables are reported in Table A5 in the Appendix. Table 2 shows our main results: in column (1) only control variables are regressed against the probability of innovating; in column (2) the variables *firms*, *univ* and *busass* are added to the regression and marginal effects are calculated and reported in column (3); the interaction terms *immigr*firms*, *immigr*univ* and *immigr*busass* are added in columns (4), (5) and (6), respectively, thereby allowing to test hypotheses 1, 2 and 3.

In column (2), we observe that companies interacting with other firms and with universities and research centres have a significantly larger probability of pursuing an innovative activity compared with companies that are not interacting. In particular, developing a network of collaboration with firms increases the probability of innovation by 14.8%, while interacting with universities and research centres increases the probability of innovating by 20%. The interaction effect in column (4) shows that collaborating with other companies does not have any additional effect on the sample of immigrant-owned firms. In contrast, collaborating with universities and research centres as well as with business associations has a significantly larger effect on immigrant-owned companies, as shown by the statistically significant coefficients of the interaction terms in columns (5) and (6). The Wald tests carried out on the interaction terms further corroborate the latter results. Therefore, Hypothesis 1 is partially supported by our data. Among control variables, while firm age and size do not seem to play a significant role, intangible fixed assets and sectoral dummies both positively influence the dependent variables, as expected.

Table 2 - Probit regressions. Hypotheses 1, 2 and 3: effects of the network of collaboration with firms, universities and research centers, and business associations.

	BASELINE MODELS			INTERACTION MODELS		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	innov	innov	margins	innov	innov	innov
immigr	-0.180	-0.292	-0.0915	-0.109	-0.418	-0.542*
	(0.238)	(0.253)	(0.0785)	(0.329)	(0.267)	(0.315)
firms		0.474**	0.148**	0.721**	0.467**	0.466**
		(0.233)	(0.0705)	(0.338)	(0.236)	(0.233)
immigr*firms				0.256		
				(0.323)		
univ		0.653**	0.205**	0.676**	0.0133	0.612*
		(0.330)	(0.100)	(0.327)	(0.485)	(0.334)
immigr*univ					1.053***	
					(0.408)	
busass		0.264	0.0829	0.251	0.267	-0.102
		(0.254)	(0.0794)	(0.256)	(0.255)	(0.352)
immigr*busass						0.702*
						(0.364)
agefirm	-0.0285	-0.0255	-0.00799	-0.0207	-0.0242	-0.0276
	(0.0378)	(0.0401)	(0.0125)	(0.0407)	(0.0409)	(0.0405)
l_turn(t-3)	0.0222	0.0183	0.00573	0.0161	0.0214	0.0269
	(0.0245)	(0.0250)	(0.00778)	(0.0250)	(0.0254)	(0.0265)
l_nintang(t-3)	0.119***	0.113***	0.0355***	0.116***	0.117***	0.116***
	(0.0252)	(0.0265)	(0.00679)	(0.0261)	(0.0269)	(0.0271)
manuf	0.772	1.056**	0.331**	1.096**	1.040**	0.930**
	(0.472)	(0.449)	(0.135)	(0.455)	(0.449)	(0.446)
ict	1.083**	1.364***	0.427***	1.384***	1.389***	1.299***
	(0.485)	(0.477)	(0.140)	(0.486)	(0.468)	(0.477)
Constant	-1.140**	-1.708***		-1.842***	-1.694***	-1.546***
	(0.527)	(0.550)		(0.574)	(0.556)	(0.554)
Wald tests						
Chi2		11.91		0.63	6.68	3.72
Prob>Chi2		0.0077		0.42	0.00	0.05
Observations	140	140	140	140	140	140
r2_p	0.143	0.194		0.199	0.205	0.206
p	0.000171	5.16e-05		3.00e-05	1.99e-05	0.000124
chi2	26.62	35.35		38.59	39.61	35.02
ll	-82.59	-77.65		-77.19	-76.58	-76.46

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

We provide additional evidence for the results by plotting the statistically significant interaction terms. Figures 2 and 3 show the predictive margins of the probability of innovating for immigrant- and native-owned companies. Interacting with universities and research institutions has a larger positive effect on the probability of innovating for immigrant-owned firms, while it has a negligible

effect on native-owned companies (Figure 2). Similarly, interacting with business associations has a larger positive effect on the probability of innovating for immigrant-owned firms, while it seems to decrease it for native-owned firms (Figure 3).

Figure 2 Plot of interaction term univ*immigr from Table 4 column (5).

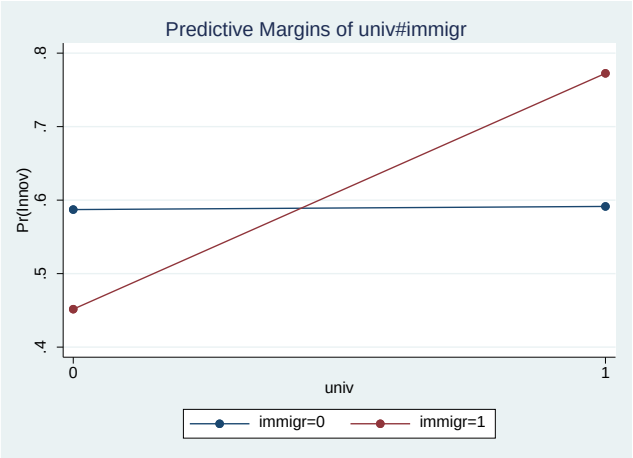
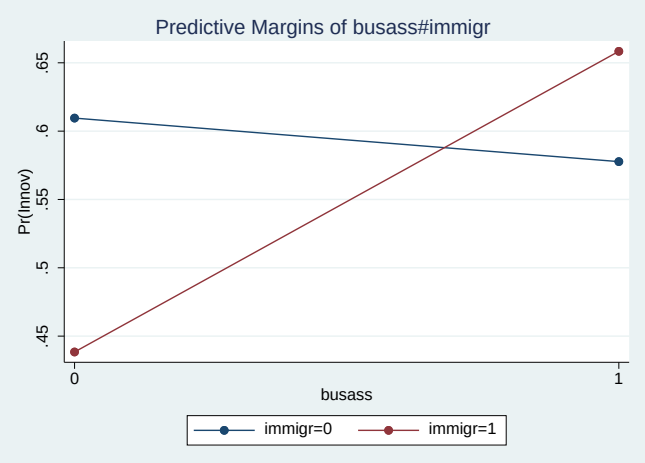


Figure 3 Plot of interaction term busass*immigr from Table 4 column (6).



To test hypothesis 4, we add the regressor *accult* and in turn the interaction terms *firms*accult*, *univ*accult* and *busass*accult* in separate regressions (see Table 3). The results show that acculturation to the host country has a statistically significant moderating effect on the relationship between linkages with business associations and innovation in the sub-sample of immigrant-owned companies. This means that the positive influence of interactions with business associations on the

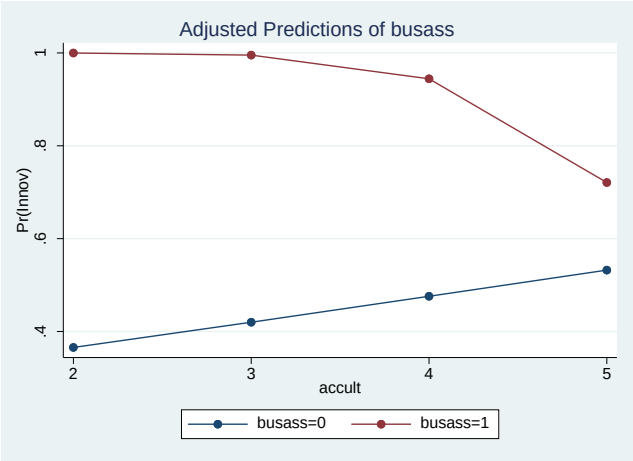
probability to innovate is weaker for immigrant entrepreneurs who feel highly acculturated to the Italian culture. This result is confirmed by Figure 4, where we plot the acculturation level and the predictive margins of the probability of innovating across the groups of immigrant entrepreneurs interacting with business associations and those not interacting with them. As the level of *accult* increases, we observe a decreasing probability of innovating for immigrant firms collaborating with business associations, hence suggesting a substitution effect.

Table 3 - Probit regression. Hypothesis 4: moderating effect of acculturation in the sub-sample of immigrant-owned companies.

VARIABLES		(1) innov	(2) innov	(3) innov
accult		-0.150	0.0187	0.141
		(0.251)	(0.232)	(0.270)
firms		-2.335	0.140	0.135
		(1.807)	(0.360)	(0.366)
firms*accult		0.603		
		(0.437)		
univ		0.839*	1.004	0.933**
		(0.451)	(1.587)	(0.440)
univ*accult			-0.0218	
			(0.376)	
busass		0.785**	0.873**	6.245***
		(0.387)	(0.381)	(2.331)
busass*accult				-1.148**
				(0.532)
agefirm		-0.00395	0.00597	0.0204
		(0.0646)	(0.0616)	(0.0657)
l_turn(t-3)		0.0499	0.0475	0.0511
		(0.0394)	(0.0363)	(0.0384)
l_nintang(t-3)		0.152***	0.145***	0.154***
		(0.0426)	(0.0419)	(0.0447)
manuf		-3.890***	-3.988***	-3.804***
		(0.565)	(0.551)	(0.544)
ict		-3.299***	-3.373***	-3.185***
		(0.615)	(0.601)	(0.613)
Constant		2.837**	2.202*	1.420
		(1.239)	(1.242)	(1.452)
Wald tests				
	Chi2	1.91	0	4.65
	Prob>Chi2	0.16	0.95	0.03
Observations		71	71	71
ll		-34.20	-35.01	-33.29
chi2		365.7	369.1	372.8
p		0.0000	0.0000	0.0000
r2_p		0.304	0.288	0.323

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 4 Plot of interaction term busass*accult from Table 5 column (3).



4.3 Robustness checks

To corroborate our findings, we carry out two robustness checks in which we employ a different econometric method and different measures of networking. First, we replicate the analysis presented in Table 2 separately on the two sub-samples of immigrant and non-immigrant owned firms (see Table 4). This econometric approach allows us to directly investigate the impact of every single regressor on the probability of innovating among immigrant and domestic firms. Such sub-sample analysis confirms the results of Table 2, thus showing that developing collaboration networks with universities and research centres as well as with business associations increases the probability of innovating among immigrant-owned firms. The results further show that interacting with firms is particularly beneficial for native owned firms.

Table 4 – Robustness check, hypotheses 1, 2 and 3. Probit regressions and marginal effects on sub-samples of immigrant-owned (col. (1) and (2)) and native-owned firms (col. (3) and (4)).

	(1)	(2)	(3)	(4)
	immigr	margins_immigr	nonimmigr	margins_nonimmigr
VARIABLES	innov	y1	innov	y1
firms	0.141	0.0389	0.767**	0.237**
	(0.350)	(0.0965)	(0.338)	(0.0979)
univ	0.914**	0.253**	0.171	0.0529
	(0.433)	(0.113)	(0.498)	(0.154)
busass	0.875**	0.242**	-0.00847	-0.00262
	(0.375)	(0.0956)	(0.367)	(0.113)
agefirm	0.00521	0.00144	-0.0392	-0.0121
	(0.0601)	(0.0166)	(0.0640)	(0.0196)
l_turn(t-3)	0.0477	0.0132	-0.000701	-0.000217
	(0.0354)	(0.00977)	(0.0446)	(0.0138)
l_nintang(t-3)	0.145***	0.0400***	0.115***	0.0355***
	(0.0422)	(0.00878)	(0.0377)	(0.00994)
manuf	-3.988***	-1.105***	1.203**	0.372***
	(0.552)	(0.211)	(0.484)	(0.140)
ict	-3.375***	-0.935***	1.366***	0.423***
	(0.612)	(0.229)	(0.530)	(0.152)
Constant	2.284***		-1.471**	
	(0.871)		(0.652)	
Observations	71	71	69	69
ll	-35.01		-37.98	
chi2	365.5		20.81	
p	0.0000		0.0077	
r2_p	0.288		0.191	

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Secondly, we replicate the results of Tables 2 and 3 after replacing the previously employed dichotomous variables (*firms*, *univ*, *busass*) with the original 1-7 scale responses provided by entrepreneurs variables (*firms_value*, *univ_value*, *busass_value*), indicating the extent to which they interacted with external organisations (see Tables 5 and 6). Table 5 presents the estimates that employ the 1-7 scale response variables *firms_value*, *univ_value* and *busass_value*. Both full-sample and sub-sample analyses confirm our previous findings. We then check the robustness of our findings about the moderation effect of *accult* by employing *firms_value*, *univ_value* and *busass_value* as independent variables instead of the dichotomous variables previously used (see Table 6). The results confirm the moderation effect on the extent of interaction with business associations.

Table 5 – Robustness check, hypotheses 1, 2 and 3. Probit regressions and marginal effects on full sample (col. (1) and (2)), on sub-samples of immigrant-owned (col. (3) and (4)) and native-owned firms (col. (5) and (6)).

	Full sample		Immigrant owned firms		Native owned firms	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Probit	ME	Probit	ME	Probit	ME
immigr	-0.352	-0.106				
	(0.252)	(0.0747)				
firms_value	0.110*	0.0331**	0.0276	0.00763	0.183**	0.0543**
	(0.0580)	(0.0168)	(0.0888)	(0.0244)	(0.0814)	(0.0225)
univ_value	0.323***	0.0971***	0.354**	0.0977**	0.234**	0.0694**
	(0.111)	(0.0330)	(0.179)	(0.0485)	(0.113)	(0.0339)
busass_value	0.103	0.0311	0.241**	0.0666***	0.0150	0.00444
	(0.0640)	(0.0190)	(0.101)	(0.0254)	(0.0865)	(0.0257)
agefirm	-0.0279	-0.00838	0.000428	0.000118	-0.0546	-0.0162
	(0.0409)	(0.0122)	(0.0589)	(0.0163)	(0.0638)	(0.0185)
l_turn(t-3)	0.0212	0.00637	0.0541	0.0150	0.00239	0.000709
	(0.0261)	(0.00778)	(0.0374)	(0.0101)	(0.0446)	(0.0132)
l_nintang(t-3)	0.112***	0.0338***	0.141***	0.0389***	0.113***	0.0334***
	(0.0272)	(0.00674)	(0.0424)	(0.00879)	(0.0380)	(0.00975)
manuf	1.285***	0.386***	-2.643***	-0.730**	1.263**	0.374***
	(0.486)	(0.139)	(1.011)	(0.307)	(0.497)	(0.138)
ict	1.583***	0.476***	-2.076**	-0.574*	1.345**	0.399**
	(0.516)	(0.145)	(1.058)	(0.317)	(0.564)	(0.157)
Constant	-2.507***		0.375		-1.978***	
	(0.654)		(1.388)		(0.708)	
Observations	140	140	71	71	69	69
ll	-74.69		-34.87		-36.52	
chi2	44.03		359.9		30.03	
p	0.0000		0.0000		0.0002	
r2_p	0.225		0.291		0.222	

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6 – Robustness check, hypothesis 4. Probit regressions on sub-sample of immigrant-owned firms.

VARIABLES	(1) accultfirm innov	(2) accultuniv innov	(3) accultbusass innov
accult	-0.497	-0.104	0.567
	(0.357)	(0.353)	(0.432)
firms_value	-0.767*	0.0266	0.0396
	(0.449)	(0.0905)	(0.0913)
accult*firms_value	0.192*		
	(0.106)		
univ_value	0.325*	0.123	0.387**
	(0.189)	(0.841)	(0.174)
accult*univ_value		0.0562	
		(0.202)	
busass_value	0.214**	0.242**	1.816*
	(0.108)	(0.102)	(0.945)
accult*busass_value			-0.349*
			(0.202)
agefirm	-0.00766	-0.00188	0.0174
	(0.0629)	(0.0600)	(0.0659)
l_turn(t-3)	0.0526	0.0546	0.0505
	(0.0408)	(0.0385)	(0.0397)
l_nintang(t-3)	0.151***	0.140***	0.153***
	(0.0443)	(0.0420)	(0.0448)
manuf	-3.542***	-2.578**	-2.429**
	(0.895)	(1.057)	(1.009)
ict	-2.929***	-2.020*	-1.837*
	(0.729)	(1.101)	(1.054)
Constant	3.417*	0.754	-2.515
	(1.760)	(1.830)	(2.626)
Observations	71	71	71
ll	-33.41	-34.84	-33.04
chi2	.	361.8	379.2
p	.	0.0000	0.0000
r2_p	0.320	0.291	0.328

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

5. Discussion and conclusion

This paper has investigated the role of networks of collaboration in the innovative activities of immigrant-owned firms compared to that of native-owned firms. We hypothesize that collaboration with external actors such as firms, academic and research centres, and business associations, increases the probability of innovating more for immigrant-owned firms than for comparable native-owned

domestic firms. Additionally, we posit that the extent of immigrant entrepreneurs' acculturation to the host country culture influences the role of collaboration networks for innovation, notably weakening their positive effect on the likelihood of carrying out innovative activities through a substitution effect. Our hypotheses are grounded in the innovation literature devoted to the study of firms' interactions with external organizations for innovation, and in the immigrant entrepreneurship literature addressing the role of relationships with non-co-ethnic, external agents in immigrant-owned firms. The empirical analysis is implemented on a dataset made up of a unique and original survey of comparable immigrant-owned and native-owned firms operating in domestic high-tech markets in the Emilia-Romagna region of Italy, combined with additional firm-level secondary data sources.

The regression analyses show that interacting with academic and research institutions as well as with business associations has a significantly larger effect on the innovation propensity of immigrant-owned companies. The robustness checks carried out on the two sub-samples of immigrant- and native-owned firms additionally show that interactions with firms have a larger effect on the latter group. Our data also show that the higher is the extent of immigrants' acculturation to the host country culture, the lower is the influence of business associations on the probability of innovating, hence suggesting a substitution effect exerted by immigrants' integration into the host country culture.

This work provides interesting associations between immigrant-owned companies' innovation behaviour and their interactions with other organizations, hence adding to the literature and policy debates on this topic. Our findings are generally in line with extant innovation literature as far as the positive influence of the network of collaboration on innovation activities is concerned (see, e.g., Allen and Cohen, 1969; Arora and Gambardella, 1990; Cassiman and Veugelers, 2006). In fact, our study shows a positive and significant effect of the interactions for two out of the three external actors considered in our empirical analyses, namely, other firms and academic/research institutions, for all the sampled firms. Most importantly, our results add to the innovation and entrepreneurship literature the finding that some of these interactions are more important for

immigrant-owned than for native-owned firms. Whereas the extant literature has shown that innovation strategies are relevant for immigrant entrepreneurs in high-tech sectors (e.g., Chaganti et al., 2008; Hart and Acs, 2011), to date, we have limited knowledge about the specific role of external knowledge networks for innovation in immigrant-owned firms (Neville et al., 2014; Kerr and Kerr, 2019), especially those operating solely in the domestic market. In particular, our findings underscore the key role of academic and research institutions and that of intermediary business associations in supporting immigrant businesses. Universities and research centres provide research infrastructures and expertise (e.g., via collaborative research, training, consulting, or placement of graduate students) that are necessary to survive in highly competitive markets, such as those in which NTBFs operate. Immigrant entrepreneurs operating in these contexts are likely to find a more supportive environment inside academia and research organizations, where their education and technical expertise may be better recognized. In addition, a similar technological background between immigrant owners of high-tech companies and workers inside academic and research institutions might help overcome the differences in cultural and institutional norms between firms and the research system. As far as business associations are concerned, our interviews with entrepreneurs confirmed that these act as intermediary bodies for immigrant entrepreneurs with regard to several dimensions of business activities, including those that relate to innovation (e.g., consulting on intellectual property rights management, connection to innovation networks, information about regional/national/international innovation funding schemes). Our analyses show that business associations are fundamental to supporting the innovation activities of immigrant-owned companies. We thus support the argument that business associations perform an innovation enabling role for these firms because they supply them with diverse and bridging network ties and expertise, which small and medium-sized immigrant owned companies often lack. Lastly, the relationships with firms appear to be relevant for all companies but do not seem to play a diversified role in immigrant-owned as compared to native-owned companies. In contrast, some of our estimates show that interacting with other firms is of key importance to native-owned firms. This finding could signal that both immigrant and native

entrepreneurs are able to establish the trust-based relationships needed for inter-firm collaboration. Yet, our measure of collaboration with other firms might not capture the nuances of interactions with different partners, such as suppliers, competitors, or clients, hence calling for further research that accounts for such features of collaboration networks.

Generally, our results support the argument that the role of the family and ethnic community in the transfer of resources are no longer unique sources of support for immigrant entrepreneurs (Arrighetti et al., 2014; Barrett et al., 2002). Instead, our findings show that increasing investments into building relationships with formal institutions, such as universities and business associations, are extremely important for immigrant entrepreneurs. In relation to this, we believe that our finding of a substitution effect of acculturation to the host country culture on the relationship between interactions with business associations and innovation paves the way for future research on the key role of immigrant entrepreneurs' acculturation orientations (Arrighetti et al., 2017; Dheer, 2018).

As with any study, this work has some limitations. Firstly, the study was conducted in a single region of a single country—Italy. While this context provides interesting insights into Southern Europe, thus answering calls for research in this area (Ilhan-Nas et al. 2011), we acknowledge that a wider geographical scope would allow a broader validity of the results and a more accurate description of firms' engagement with external networks of collaborations. Secondly, the study focused on non-internationalized technology-based companies, but we recognize that innovation could be carried out in a wider set of industries, both domestically and abroad. Future studies should therefore provide an extension of our findings for other countries, industries, and markets. Thirdly, the cross-sectional data used for the empirical analysis do not allow us to ascertain neat causality relationships, because of the potential reverse causality between the likelihood of innovation and the importance of networks of collaboration. In particular, while we argue and empirically show that networks of collaboration exert a positive influence on immigrant businesses' probability of innovating, it may also be that more innovative firms are more likely to resort to inter-organizational linkages to strengthen their position on the market. However, our empirical setting allows us to

control for highly relevant lagged factors influencing innovation, such as firm age, size, R&D effort and industry, hence limiting the extent to which endogeneity hampers our estimations. Future research efforts should exploit longitudinal data, when available, with appropriate econometric techniques aimed at properly disentangling causality connections.

To conclude, this work provides implications for the academic community and for policy makers interested in the role of public policies to foster firm-level innovation, especially those targeting the specific subset of immigrant entrepreneurs. Specifically, this work supports the argument that while the development of networks of collaboration with external actors is important for making firms more innovative, some of these interactions matter more for immigrant-owned businesses. Our study thus suggests that appropriate public-policy instruments should support domestic immigrant-owned businesses in developing networks of collaboration with host country universities, research bodies, and business associations to be more innovative and hence more competitive and productive in the economy of the host country. This suggestion is relevant, given the tendency of business support programmes targeting immigrant entrepreneurs to focus on measures enhancing the skills of individual entrepreneurs (e.g., information, education, mentoring, training, or counselling) rather than on those focusing on structural features (Rath & Swagerman, 2016). Public policy actions should therefore point to strengthening immigrant entrepreneurs' relationships with local intermediaries, emphasizing the development of joint programmes with local organizations and native entrepreneurs and managers, rather than detaching them from "mainstream" business support initiatives (Ram et al., 2017). Both practitioners and policy makers should nevertheless be aware that efforts in this direction should be accompanied by an increasing cross-cultural sensitivity of the bureaucracy and attention to "tailor-made" approaches (e.g., services in immigrant languages, intercultural mediators, outreach officers) (Rath and Swagerman, 2016; Solano et al., 2019). Examples of policies that might accomplish such objectives include the implementation of "start-up visa" programmes entailing the incubation of immigrant-owned firms into certified mainstream incubators in the host country (e.g., de Lange, 2018). Additionally, practitioners and policy makers

should increasingly be aware that immigrant entrepreneurs cannot be seen as a homogeneous category (e.g., Ram et al., 2013). As a matter of fact, our study considered different levels of immigrant entrepreneurs' acculturation to the host country culture, showing that cultural incorporation acts as a substitute for interaction with local business associations with respect to innovation propensity. Our results thus reinforce calls for nuanced policy approaches to sustain innovation among immigrant entrepreneurs (e.g., Ram et al., 2013).

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APPENDIX

Table A1 - Summary of the sample selection process for immigrant entrepreneurs' firms

1) Full population established by at least a foreign-born partner in high-tech and machinery sector in last 10 years	n = 560
2) Non-independent companies to be excluded	n = 53
3) Firms starting a failure process to be excluded	n = 37
Subtotal A) Independent active firms	n = 470
4) Companies with no contact to be excluded	n = 194 (*)
5) Companies already active on international markets to be excluded	n = 60
6) Companies not reachable through any contact (4 rounds of contacts)	n = 69
7) Companies where the foreign-born partner is not active	n = 7
Subtotal B) Independent, active, non-international companies to be included	n = 140
8) Companies not interested in the project	n = 69
Subtotal C) Independent, active, non-international companies interviewed	n = 71
9) Companies owned by "chance" foreign-born entrepreneurs	n = 17
Subtotal D) Independent, active, non-international, ethnic-immigrant-owned companies	n = 54
10) Companies owned by immigrant entrepreneurs from OECD countries	n = 17
Subtotal E) Independent, active, non-international, developing-country-immigrant-owned companies	n = 37

(*) This number reflects a documented problem in the management of the Italian business official directories, where many inactive, failed or closed firms do not officially close their position at the Chamber of Commerce. To this extent, the regulation D.P.R. 247/2004 established a procedure to allow the default deletion from the business directories after three years of missing documentation. This problem might be further exacerbated by the peculiarity of the selected sample (foreign-born entrepreneurs), for different reasons (e.g., individuals who opened a firm just as a means of obtaining a work visa for Italy and do not carry out any 'real' activity or left the country; individuals whose firms failed or closed down and were not aware that they have to close their position at the Chamber of Commerce; etc.). Because it was not possible to find these firms in any manner, we do not consider these firms in the calculation of our response rate.

Table A2 - Localization of firms

Province	**Sample**		**Regional population [a]**	
	N	**% on total**	**N**	**% on total**
Piacenza	6	4.3%	23818	6.2%
Parma	17	12.1%	38525	10.1%
Reggio Emilia	15	10.7%	43695	11.4%
Modena	25	17.9%	59990	15.7%
Bologna	34	24.3%	89139	23.3%
Ferrara	9	6.4%	26202	6.9%
Ravenna	11	7.9%	30923	8.1%
Forlì-Cesena	0	.0%	35280	9.2%
Rimini	23	16.4%	34614	9.1%
Total	**140**	**100.0%**	**382,186**	**100.0%**

[a] Source: ISTAT, Asia archives (2010)

Table A3 - Firms' characteristics: Native- vs. immigrant-owned firms

	Native-owned			Immigrant-owned			
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**Difference** ***p-value***
Firm age	69	6.04	3.52	71	5.69	3.88	0.574
N. of employees (t-1)	69	4.06	1.06	71	3.87	6.06	0.885
N. of partners (t-1)	69	2.33	1.60	71	2.58	1.99	0.426
Equity	69	16442.65	26171.83	71	13821.83	23191.24	0.734
% of business-to-business sales	69	90.74	24.75	71	94.63	17.71	0.282
% of regional clients	69	69.35	32.91	71	75.32	29.70	0.261
% of Italian-nationals clients	69	96.52	17.03	71	97.22	13.41	0.786
% of regional suppliers	69	64.89	36.05	71	55.51	41.42	0.155
% of Italian-nationals suppliers	69	82.07	38.07	71	77.18	41.99	0.472
% of regional competitors	69	60.20	38.39	71	58.13	38.78	0.751

Table A4 - Entrepreneurs' characteristics: Native vs. immigrant entrepreneurs

	Native			Immigrant			
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**Difference** ***p-value***
Entrepreneur age	69	41.71	8.25	71	41.24	8.21	0.736
Entrepreneur gender (male)	69	0.81	0.39	71	0.72	0.45	0.196
Years of education	69	14.59	3.34	71	15.45	3.08	0.123
Years of work experience	69	13.18	9.03	71	12.22	7.43	0.493
Years of work in Italy	69	13.71	9.02	71	10.50	7.75	0.062
Portfolio entrepreneur (a)	69	0.22	0.41	71	0.29	0.45	0.292
Years working as entrepreneur	69	9.83	6.63	71	8.93	7.04	0.439
Necessity entrepreneur	69	0.19	0.39	71	0.28	0.45	0.196

(a) Dummy variable being 1 if the entrepreneur is owner of other companies, 0 otherwise.

Table A5 - Correlation table

	innov	firms	univ	busass	accult	immigr	agefirm	l_turn(t-3)	l_nintang(t-3)	manuf	ICT	others
innov	1											
firms	0.1833*	1										
univ	0.2104*	0.0849	1									
busass	0.1436*	0.1228	0.1574*	1								
accult	0.0535	0.0633	-0.0627	0.1163	1							
immigr	-0.0589	0.0589	0.1401*	-0.0848	-0.5851*	1						
agefirm	-0.1074	0.0177	-0.0921	0.1367	0.0612	-0.048	1					
L_turn(t-3)	0.1978*	0.0328	-0.0212	0.2358*	0.1227	-0.1327	0.0981	1				
L_nintang(t-3)	0.1144	-0.0438	-0.0426	0.129	0.0445	-0.0731	-0.0389	0.6714*	1			
manuf	-0.0777	-0.1237	-0.1009	0.1471*	-0.1254	0.0994	0.1245	0.1562*	0.0845	1		
ICT	0.1067	0.0979	0.0529	-0.1972*	0.0622	0.0027	-0.1313	-0.1628*	-0.0738	-0.8775*	1	
others	-0.0556	0.0556	0.0995	0.0956	0.1306	-0.2076*	0.0097	0.0083	-0.0242	-0.2775*	-0.2172*	1

N=140. Coefficients significant at 10% level